Automated Design of Prediction Market Pricing Functions

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One of the most famous algorithms for constructing an automated market maker in a Prediction Market is derived from the logarithmic scoring rule. The logarithmic scoring rule, however, does not provide uniform liquidity on the entire spectrum of prices from 0 to 1. Consequently, a user who changes the price of a security from 0.01 to 0.02 expects to gain much more than a user who changes the price of a security from 0.11 to 0.12 (assuming, of course that 0.02 and 0.12 respectively were the correct probabilities). Participants have high incentives to make small corrections to prices that are either very close to 0 or very close to 1 (although the logarithmic scoring rule does not allow the price to go all the way to 0 or all the way to 1), but have much lower incentives to correct prices that fall in the middle range.

This fact may create problems when the participants must exert costly effort to acquire information: they will have the incentive to obtain new information only for extreme predictions. Many applications, however, require accurate predictions for the middle range. Consider for example, a prediction market on the outcome of presidential elections. If the race is clear (one candidate is almost certain of winning the election) fine grained correction to the market price do not bring any value to the prediction. If, on the other hand, the race is tight, and the chances of one candidate winning are around 50% it is very important that market participants have high incentives to make small corrections to the price, because these small corrections will improve the final prediction.

An alternative to the logarithmic scoring rule is the quadratic scoring rule which provides uniform liquidity along the whole probability spectrum.

The goal of this project is to design other pricing mechanisms for prediction markets that allow a fine tuning of incentives along the probability spectrum. For example, the market sponsor should be able to specify the intensity of the incentives to correct the price by Δp in the right direction for the whole probability spectrum. Moreover, the pricing mechanism should guarantee the desired incentives to correct the market price through a minimum subsidy required from the market sponsor. The methodology proposed here is that of

Automated Mechanism Design where the price function is the result of an optimization problem with the objective to minimize the subsidy in the market under the constraints that price corrections bring at least the desired amounts dictated by the interests of the market sponsor.